

An aerial photograph showing a large, dark green pond labeled 'A18' in the center. The pond is surrounded by a mix of green fields, brownish soil, and some developed areas with buildings and roads. The text '2005 Annual Self-Monitoring Program Report for Pond A18 - February 1, 2006' is overlaid in the top left corner.

2005 Annual Self-Monitoring Program Report for Pond A18 - February 1, 2006

A18

**2005 Annual Self-Monitoring Program Report
for Pond A18 in Santa Clara County**

Order No. R2-2005-0003

Prepared for:

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Table of Contents

1. Introduction	1
a. Waste Discharge Requirements	1
b. Monitoring Requirements	1
2. Annual Summary	4
a. Continuous Monitoring of Water Quality	4
Salinity	4
Temperature	4
pH.....	5
Dissolved Oxygen	5
b. Discrete Monitoring	7
Salinity	7
pH.....	8
Chlorophyll a	8
Dissolved Oxygen	8
Metals.....	9
Sediment Mercury.....	9
Invertebrates.....	10
Turbidity	10
c. Calibration and Quality Control.....	11
3. Exceedances of Limits or Triggers	11
a. Summary of Exceedances	11
Table 4: Pond A18 Exceedances of Water Quality Objectives & Trigger Levels and Corrective Action.....	11
b. Corrective Action.....	12
c. Lessons Learned.....	12
4. Winter Operation	13
5. 2006 Plan	13

1. Introduction

This report summarizes the results of the 2005 water quality sampling conducted for Pond A18 in Santa Clara County. Operations occurred from February through December 2005. Sampling was performed by Cargill and City of San Jose staff as required by the Waste Discharge Requirements of Order No. R2-2005-0003 (Order) issued on February 16, 2005 by the San Francisco Bay Regional Water Quality Control Board (Regional Water Board).

Figure 1 shows A18 with its intake and discharge structures and sampling sites in the pond and receiving water.

a. Waste Discharge Requirements

The Order recognized two periods of discharges from the pond: the Initial Release Period when salinity levels would decrease from the initial levels in the pond and a Continuous Circulation period after salinities reached the 44 ppt salinity discharge limit. Different monitoring plans were identified in the Order for each period.

The applicable discharge limitations are as follows (taken from the Order):

1. Pond A18 waters discharging to Artesian Slough shall meet the following limits:

<u>Constituent</u>	<u>Instantaneous Maximum</u>	<u>Instantaneous Minimum</u>	<u>Units</u>
Salinity for continuous circulation	44		ppt
Dissolved Oxygen ¹		5.0	mg/L
pH ²	8.5	6.5	

¹ The Discharger may select discharge station A-A18-D, or receiving water station A-A18-5 to evaluate compliance with the dissolved oxygen limitation. In cases where receiving waters do not meet the Basin Plan objective, the Discharger must show, as described in its Operations Plan, that pond discharges do not further depress the dissolved oxygen level in the receiving water.

² The Discharger may select discharge station A-A18-D, or receiving water monitoring A-A18-5 to evaluate compliance with the pH limitation.

2. Pond waters discharging to Artesian Slough shall not exceed the natural temperature of the receiving waters by 20°F, or more.
3. Dissolved Oxygen Trigger. The Discharger shall monitor, report, and take corrective action measures, in accordance with the Operations Plan required by Provision D.2, if dissolved oxygen levels in Pond A18 at station A-A18-M fall below 1.0 mg/L during the continuous circulation period [note: the Regional Water Board allowed Cargill to monitor A-A18-M at the discharge (outlet arrow in Figure 1)].

b. Monitoring Requirements

Monitoring requirements for the initial release and continuous circulation periods are as follows:

TABLE 1 – INITIAL RELEASE MONITORING FOR POND A18

Sampling Station:	D.O.	PH	Temp	Salinity	Turbidity	Benthos	Sample Function
A-A18-M	A	A	A	A			Management
A-A18-D	B	B	B	B			Discharge
A-A18-1	D	D	D	D	D	C	Receiving Water
A-A18-2	D	D	D	D	D	C	Receiving Water
A-A18-3	D	D	D	D	D	C	Receiving Water
A-A18-4	D	D	D	D	D	C	Receiving Water
A-A18-5	E	E	E	E			Receiving Water

LEGEND FOR TABLE 1

- A = Monitoring shall be conducted within Pond A18 at least twice per month for at least the previous 2 months before discharge commences. Dissolved oxygen monitoring shall be conducted between 0800 and 1000 hours. Time of monitoring shall be reported.
- B = Once discharge begins, discharge monitoring shall be conducted before pond water mixes with receiving water using a continuous monitoring device. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.
- C = Samples for benthos shall be collected from discrete locations at the convenient stage of tide at the following frequency: within one week before initiating discharge, 14 days (± 2 days) after the initial discharge, 28 days (± 2 days) after, once in the late summer (August/September), and then once in the late summer of the following year.
- D = Receiving water monitoring shall be conducted at discrete locations from downstream to upstream at the following frequency: within one week before initiating discharge, one day (± 1 day) after the initial discharge, 3 days (± 1 day) after, 7 days (± 1 day) after, then weekly until the Discharger documents that discharge salinity levels are below 44 ppt. For days it monitors receiving waters, the Discharger shall also (1) document if it monitors at flood tide, ebb tide, or slack tide, (2) monitor receiving water for dissolved oxygen, pH, temperature, salinity, and turbidity near the water surface and bottom, and (3) report standard observations, as described in Section D of the SMP.
- E = Receiving water continuous monitoring for the purposes of determining compliance with the dissolved oxygen and pH limits shall be conducted at a location selected by the Discharger and approved by the Executive Officer at a point downstream of the discharge. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

TABLE 2 – CONTINUOUS CIRCULATION MONITORING FOR POND A18

Sampling Station:	D.O.	pH	Temp	Salinity	Turbidity	Chlorophyll <i>a</i>	Metals/Water Column	Sample Function
A-A18-M	A	A	A	A		A		Management
A-A18-D	B	B	B	B			C	Discharge
A-A18-1	D	D	D	D	D			Receiving
A-A18-2	D	D	D	D	D			Receiving
A-A18-3	D	D	D	D	D			Receiving
A-A18-4	D	D	D	D	D			Receiving
A-A18-5	E	E	E	E				Receiving

LEGEND FOR TABLE 2

A = Monitoring shall be conducted within Pond A18 monthly from May through October. Dissolved oxygen monitoring shall be conducted between 0800 and 1000 hours. Time of monitoring shall be reported.

B = Discharge monitoring shall be conducted before pond water mixes with receiving water using a continuous monitoring device from May through October. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

C = Water column samples for total and dissolved arsenic, chromium, nickel, copper, zinc, selenium, silver, cadmium, lead, and mercury shall be collected annually in August or September. When collecting metals samples, the Discharger shall also monitor for salinity, and total suspended solids.

D = Receiving water monitoring shall be conducted at discrete locations from downstream to upstream monthly from May through October. The positions indicated on Figures 1 should be considered approximate. For days it monitors receiving water, the Discharger shall also (1) document if it monitors at flood tide, ebb tide, or slack tide (samples shall be collected as close to low tide as practicable), (2) monitor receiving water for dissolved oxygen, pH, temperature, salinity, and turbidity near the water surface and bottom, and (3) report standard observations, as described in Section D of the SMP.

E = Receiving water continuous monitoring for the purposes of determining compliance with the dissolved oxygen and pH limits shall be conducted from May through October at a location selected by the Discharger and approved by the Executive Officer at a point downstream of the discharge. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

In addition to the monitoring requirements listed in the two tables above, annual sampling for mercury and methyl mercury is required in August or September of each year.

2. Annual Summary

This section summarizes the activities performed during the 2005 calendar year at Pond A18 to comply with the Order.

Cargill commenced discharge from A18 on February 17, 2005. The Initial Release Period occurred between February 17 and March 30. No discharge occurred from March 30 through May 9 to coordinate with the Initial Release from U.S. Fish & Wildlife Pond A16. Initial release discharges were in compliance with all applicable limits at all times (February 17 to March 30, 2005). The discharge from A18 was re-started on May 10 with one discharge gate opened at 45 percent in accordance with the Operations Plan.

Beginning on June 14, 2005, Pond A18 was operated in an adaptive management mode to meet dissolved oxygen (DO) trigger levels specified in the Order (weekly 10th percentile should not be <3.3 mg/L). Generally, the adaptive management entailed opening the discharge during the day when DO levels were high and closing the discharge at night when levels dropped. However, management under the adaptive management mode dictated that the discharge not necessarily be opened every day, taking into account such factors as the DO level or staffing constraints.

a. Continuous Monitoring of Water Quality

Salinity

The salinity of the discharge at the beginning of the initial release was 110 ppt, and decreased steadily to 41.24 ppt when the discharge was closed on March 30. The salinity of the discharge remained below 40 ppt at all times during the continuous circulation period (due to a calibration error, salinity levels were recorded around 60 ppt for a short period in July). Pond salinity averaged approximately 31 PSU¹ during the continuous circulation period in 2005.

Temperature

Temperatures at the pond discharge varied between 11.46°C and 23.7°C for the initial release. Temperatures at the continuous monitoring location in the receiving water varied between 16.5°C and 22.32°C. The permit requires that discharge temperatures remain within 20°F (approximately 11°C) of receiving water temperatures. Data from the continuous monitors in the receiving water and at the pond discharge indicated that temperatures of the discharge were within 11°C of those in the receiving water at all times during the initial release period.

During the continuous circulation period, temperatures at the discharge location varied between 16.21° and 29.86°C during periods of pond discharge. Temperatures at the continuous monitoring location in the receiving water ranged from 18.65°C to 35.53°C. Discharge temperatures were within 11°C of receiving water temperatures at all times during the continuous circulation period.

¹ PSU – 1 Practical Salinity Unit equals approximately 1 part per thousand salinity. PSU is based on the specific conductance of the water.

pH

The Order requires that the pH objective of 6.5 to 8.5 be met either in the discharge or in the receiving water. During the 2005 operations, the receiving water experienced only one instance during which the pH was not within the Basin Plan objectives. On May 26th, the pH in the receiving water and in the discharge exceeded 8.5 from 9:30 a.m. until 11:15 a.m. Cargill reported this instance to the Regional Water Board within the specified timeframe in the Order. During the summer months, pond pH remained elevated (usually above 8.5) due to algal blooms and high rates of photosynthesis in the pond. However, this did not cause the receiving water to exceed the water quality objective of 8.5, except for the one occurrence described above.

Dissolved Oxygen

The Basin Plan DO objective of 5 mg/L was met in the receiving water at all times during the initial release period. DO levels in Artesian Slough, as measured by the continuous monitoring device at A-A18-5 (labeled 5 in Figure 1), ranged from 5.8 to 10.6 mg/L, during the initial release period. Even though DO levels at the A18 discharge location dropped below 5.0 mg/L on six separate days (typically for approximately one half hour; the lowest reading was 3.65 mg/L), these excursions did not cause the receiving water DO to fall below the water quality objective of 5.0 mg/L at any time. In addition, the discharge DO was never less than the trigger value of 3.3 mg/L (as a weekly 10th percentile value) during the initial release period.

DO levels in the discharge and in the receiving water fell below the Basin Plan objective of 5 mg/L twice during the 2005 continuous circulation period. On September 3rd, the DO in the receiving water (Station 5 in Artesian Slough – see Figure 1) and in the discharge (station D – Figure 1) was between 4.6 and 4.8 mg/L for approximately 30 minutes. For a 45-minute period from late October 1st to early October 2nd, the DO at the discharge and in the receiving water was less than 5 mg/L. There were no other exceedances of the water quality objective of 5 mg/L in the receiving water. Both incidents were reported to the Regional Water Board.

During the 2005 continuous operation, A18 experienced two instances during which the weekly 10th percentile DO level at the discharge was less than the trigger level (Table 3). Both instances were reported to the Regional Water Board within the specified reporting timeframe and adaptive management efforts were initiated. The permit calls for a 10th percentile DO trigger of 3.3 mg/L as measured on a weekly basis. DO levels at the discharge exhibited a strong diurnal pattern, with high (supersaturated) DO during the afternoon/evening and low DO during the early morning hours.

Having DO below the trigger value is not a violation of the Order. Rather, the trigger value initiates adaptive management actions as specified in the approved Operations Plan. On June 14, 2005, Cargill reported to the Regional Water Board that the 10th percentile had dropped below the trigger value, based on the most recent 168 hours (1 week) of data², and immediately initiated

² The instantaneous weekly 10th percentile DO value originally calculated on June 14, 2005, including data from the previous monitoring week, was 2.99 mg/L. The 10th percentile DO value was recalculated at the end of the monitoring week ending at 11:45 p.m. on June 18th as 2.08 mg/L as reported in Table 3.

Table 3. Weekly 10th Percentile Dissolved Oxygen Concentrations (mg/L) at Pond A18 Discharge During the Continuous Circulation Period in 2005. * Indicates values below the weekly trigger value of 3.3 mg/L. Also see footnote 2.

Discharge Period	10 th Percentile Dissolved Oxygen Concentration
May 10 th through 14 th (5 days)	8.01
May 15 th through 21 st	5.61
May 22 nd through 28 th	5.93
May 29 th through June 4 th	4.92
June 5 th through 11 th	4.11
June 12 th through 18 th	2.08*
June 19 th through 25 th	7.73
June 26 th through July 2 nd	5.63
July 3 rd through 9 th	5.17
July 10 th through 16 th	0.24*
July 17 th through 23 rd	3.68
July 24 th through 30 th	4.60
July 31 st through August 6 th	6.30
August 7 th through 13 th	5.25
August 14 th through 20 th	5.53
August 21 st through 27 th	5.33
August 28 th through September 3 rd	4.99
September 4 th through 10 th	3.62
September 11 th through 17 th	4.85
September 18 th through 24 th	6.95
September 25 th through October 1 st	4.67
October 2 nd through 8 th	4.90
October 9 th through 15 th	5.74
October 16 th through 22 nd	6.30
October 23 rd through 29 th	3.67
October 30 th through 31 st (2 days)	4.32

adaptive management actions. The adaptive management method selected was timing the discharge, by opening and closing the discharge gates, to coincide with periods of higher DO in pond discharge water. On July 18, 2005, Cargill again reported that DO for the previous week was below the trigger value, due to the timing of the adaptive management efforts and a miscommunication resulting in the discharge remaining open overnight. Adaptive management timing was improved and communications issues were addressed. Thereafter DO remained above the trigger value of 3.3 mg/L through October 31st, the end of the dry weather monitoring period.

b. Discrete Monitoring

In addition to continuous water quality monitoring at the discharge and in the receiving water, the Order requires discrete sampling of water quality at four locations in the receiving water weekly during the initial release (Table 1) and monthly during continuous circulation (Table 2). Although the Order required monitoring water quality parameters (temperature, salinity, DO, & pH) at the surface and bottom only in the receiving water, the entire water column was monitored at 1-foot intervals.

In some respects the discrete monitoring of certain parameters in the receiving water (pH, temperature and some of the dissolved oxygen measurements) was redundant to the continuous monitoring data used for compliance monitoring. However, the discrete monitoring was especially valuable in describing the “salinity wedge” in Artesian Slough during the Initial Release period (Appendix 1) and the effect of salinity on the benthic community (Appendix 5).

This "salinity wedge" is a natural phenomenon resulting from the mixing of fresh slough water with saline seawater from the Bay. The fresh water flowing down Artesian Slough floats over the top of heavier seawater in the Bay. This is observed as a notable vertical partitioning in the water column that extends the length of Artesian Slough during high and incoming tides and tends to dissipate at low tide as the seawater recedes. The resulting halocline was more pronounced than predicted in early hydrodynamic modeling indicating that turbulence in the channel was less than expected. The result was that benthic organisms living at the bottom of the channel were impacted by saline water during the initial release while those living slightly to the side of the channel were much less impacted.

Salinity

The monthly monitoring of salinity in the receiving water during the Continuous Circulation period indicated that a biologically significant (see *Invertebrates* section below) and substantial salinity wedge² usually formed in Artesian Slough during an incoming tide (Figure 2; Appendix 2). Salinity differences between the surface and bottom differed by as much as 21.8, 18.6, 21.7, and 10.4 PSU, respectively, at stations 1-4 in Artesian Slough. Differences were highly dependent upon tidal stage and whether there were simultaneous salt pond discharges to the receiving water (Appendix 2). For example, on June 14, 2005, the salinity difference between the top and bottom at station 1 was 19.5 PSU at the beginning of an ebb tide with no pond

discharge (water depth of 7 ft.). The difference was only 0.1 PSU just before low tide and during pond discharge (water depth 4 ft.).

Salinity profiles taken at the South Discharge Point in Pond A18 during the Initial Release and Continuous Circulation periods indicate that there was nearly complete vertical mixing in three to five feet of Pond water (Appendix 3).

pH

Discrete monitoring of Pond A18 and Artesian Slough during the Initial Release and Continuous Circulation periods indicates that the pond was well mixed but the receiving water was stratified with higher pH on the bottom. This stratification basically reflected the density stratification of salinity in the receiving water with saltwater having a higher pH (8, or greater) than the Plant's discharge (low 7's).

Chlorophyll *a*

Chlorophyll *a* was determined for monthly pond samples taken at the south discharge point. Algal standing crop appeared to increase over the summer with the highest chlorophyll *a* measurement in October. The noticeable algal blooms appeared to cause elevated pH levels presumably due to high rates of photosynthesis. However, pond pH varied little probably due to the rather large buffering capacity of seawater. Pond water had a salinity of approximately 31 PSU during the continuous monitoring period.

Month (2005)	pH	Chlorophyll <i>a</i> (mg/m ³)
May	8.84	19
June	8.68	66
July	8.88	74
August	8.75	99
September	8.85	94
October	8.68	300

Dissolved Oxygen

The monthly vertical profiles taken of dissolved oxygen concentrations (DO) in Artesian Slough show substantial differences in DO between the surface and bottom readings, with consistently higher readings at the surface (Appendices 1 & 2). These differences were primarily related to the haloclines established in Artesian Slough during an incoming tide. Oxygen solubility is inversely related to both salinity and temperature. The denser higher salinity water that sinks to the bottom is able to hold less oxygen than the overlying freshwater, despite a lower temperature (i.e. holds more oxygen) on the bottom. This is due to the greater role of salinity than temperature in determining oxygen solubility. The effect of increasing salinity on DO was more apparent during the Initial Release period (Figure 3-A) than during the Continuous Circulation period (Figure 3-B) due to higher salinities. The halocline itself may be a partial barrier to oxygen diffusion into the bottom water layer where decomposing organic particulates may accumulate and further deplete the DO. The maximum solubility of oxygen, based on both temperature and salinity, is also shown in Figure 3-A & B. The relationship of dissolved oxygen concentration in the receiving water to the theoretical maximum oxygen solubility indicates that salinity and temperature are important but other factors (oxidation, respiration, diffusion rates) play a role as well.

The Operations Plan (referenced in the Order) also set a dissolved oxygen trigger of 1.0 mg/L for monthly in-pond water quality to be monitored between 8:00 and 10:00 a.m., when DO was expected to be lowest. Monitoring in July and August indicated that DO was near to the 1.0 mg/L trigger (readings of 1.15 and 1.94 mg/L, respectively). On September 9th S.R. Hansen & Associates measured the DO at 0.07 mg/L. However, that data was not reported to Cargill until September 28, just as Cargill was about to transfer ownership of Pond A18 to the City. This trigger was not reported by Cargill to the Regional Water Board until January 24, 2006, following the discovery of this information by the City in preparing this report.

The main purpose for the in-pond DO trigger of 1 mg/L, according to Discharge Limitation B.4 of the Order, is “to ensure the Discharger will implement corrective measures to minimize the potential for odors, avian botulism, and mercury methylation.” The low DO measured at 8:00 a.m. on September 9th was not persistent and was part of a diurnal pattern of higher DO during the day and lower DO at night (Figure 4). Diurnal DO patterns are presumably influenced primarily by daytime photosynthesis and nighttime oxidation and respiration rates (Figure 4). Although there is insufficient data to determine the effect of low pond DO on mercury methylation, there were no odor or avian botulism incidents during 2005. Therefore, it is unlikely that this incident would have triggered additional BMPs. The pond was not discharging during the September 9th low DO incident.

Metals

Water Column metals

As required by the permit, on September 1, 2005, S.R. Hansen & Associates collected water column samples from one location in Pond A18 near the south discharge structure to determine the total and dissolved concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc (Appendix 4). In addition, the water column was analyzed for total suspended solids (TSS). The results indicate that the water discharged from the pond contains low concentrations of all 10 metals considered (Appendix 4). The measured water column concentration for each of the metals were less than the associated saltwater and freshwater criteria.³

Sediment Mercury

Pond A18 sediment was sampled at four stations on September 1, 2005 for total and monomethyl mercury, percent solids, grain size, total sulfide, pH, oxidation/reduction potential, and percent total organic carbon (Appendix 5). The quality of the overlying water was also monitored. Total and monomethyl mercury was greatest at the northernmost station (A18-4) and lowest at the southernmost station (A18-1). As expected, there was a high degree of correlation between percent organic carbon (OC) and percent clay in the sediment (Figure 5). Unexpectedly, however, both OC and percent clay were inversely related to the amount of monomethyl mercury in the sediment.

³ The freshwater criteria were based on a hardness of 100 mg/L. Therefore, they are conservative since the pond and receiving water hardness values are much greater than this.

In 2005, pond water was taken in through the northern control structure and discharged through the southern control structure. In September, the amount of monomethyl mercury measured at station 4, nearest the intake structure, was 8 times greater than that measured at station 1, near the discharge structure. If the mercury results are standardized to percent clay, the amount of monomethyl mercury at station 4 is 23 times greater than that at station 1. It is unclear as to whether these results provide an accurate description of mercury in the pond. It is also not clear as to which variables may be responsible for this distribution of mercury in the pond should these results eventually be confirmed.

Invertebrates

Cargill contracted with S.R. Hansen to perform the required benthic sampling (Appendix 6). The first set of samples was collected on February 14, 2005, which was 3 days prior to the initiation of discharge. The next three samplings occurred on March 2nd, March 18th, and September 2nd, which were 13 days, 29 days, and 6 months, respectively, following the initiation of discharge. Each sample set consisted of four separate bottom sediment grab samples taken from each of three receiving water stations (2-4) in Artesian Slough (Figure 1). The sediment samples were then analyzed for benthic macroinvertebrate community structure per the Methods section in Appendix 6.

The results of the sampling indicate that the initial discharge resulted in an expected short-term decline of the benthic invertebrate community. However, after six months of discharge all community structure and biomass indicators reveal a more diverse and abundant invertebrate community than was observed prior to the initiation of discharge. The number of species present, Shannon's Diversity Index H^4 , and the density of individuals illustrate this recovery of the benthic community after 6 months (Figure 6).

S.R. Hanson also examined the benthic community at the sides of the channel to determine if the shallower depths with lower salinity (see Figure 2) provided refugia for invertebrates that were displaced from the deeper, mid-channel areas of Artesian Slough. The "results indicate that the benthic community inhabiting the higher elevation banks of Artesian Slough was not adversely impacted by the Pond A18 discharge during the first month." The benthic communities along the banks could serve as a source of migration and new recruitment into the deeper-water regions of the slough following the high salinity disturbance in the mid-channel associated with the initial release period. "The observed recovery of the benthic invertebrate community in these deeper-water regions after only 6 months suggests that the shallow-water refuge may have played a role." The recovery of the benthos following the release of highly saline waters to Artesian Slough is clearly a positive sign and confirms the predictions for the A18 and Initial Stewardship Program discharges.

Turbidity

Turbidity was measured monthly at four stations in Artesian Slough during the Initial Release and Continuous Circulation periods. In general, turbidity increased with depth in salinity-

⁴ Shannon's Index H is a diversity index that is sensitive to species richness and evenness.

stratified waters and did not vary vertically in well-mixed waters (Appendices 1 & 2). Also, turbidity appeared to increase with distance from the treatment plant outfall, presumably due to the low TSS in the Plant's discharge and/or the greater effect of tides on turbidity in the lower reaches of Artesian Slough.

c. Calibration and Quality Control

The instruments used for sampling as part of the A18 monitoring program were calibrated and maintained properly to ensure accurate data. Sonde units (continuous water quality monitors) were calibrated prior to deployment and maintained on a weekly cleaning and calibration schedule unless additional maintenance was required.

The error associated with a sonde's dissolved oxygen probe tended to increase with time and in a negative direction (reading less than the true value) due to fouling. For this reason, the observed DO results from the continuous monitors are conservative (i.e. not likely to be less than reported). For example, the average post-deployment DO reading was 93 percent of the correct value (range of 76 – 105%).

3. Exceedances of Limits or Triggers

a. Summary of Exceedances

Table 4 summarizes the exceedances and corrective action for 2005.

Table 4: Pond A18 Exceedances of Water Quality Objectives & Trigger Levels and Corrective Action

Date	Exceedance	Corrective Action
5/26/05	pH for two hours was > 8.5 in the receiving water	Reported to WB on 5/31
6/14/05	DO trigger (<3.3 mg/L) at discharge the week immediately preceding 6/14/05. 10 th percentile DO was 2.08 mg/L for the monitoring week of 6/12-6/18/05.	Reported to WB and immediately implemented adaptive management (closing discharge at night).
7/18/05	DO trigger (<3.3 mg/L) at discharge during the week of July 10 th through 16 th	Reported to WB and corrected miscommunication on adaptive management process that had caused exceedance.
9/3/05	DO at discharge and receiving water was between 4.6 and 4.8 ppm for approximately 30 minutes.	Reported to WB
9/9/05	Monthly discrete In-Pond DO measured at the discharge at 8:00 a.m. was < 1.0 mg/L (Pond was not discharging).	Originally overlooked; Reported to WB in January 2006.
10/1 – 10/2/05	DO at discharge and in the receiving water was <5 mg/L for a 45 minute period	Reported to WB on 10/13/05.

b. Corrective Action

The primary corrective action implemented for A18 was closing the discharge gate at night when DO levels were low and opening it during the day when DO levels were above 5 mg/L. Overall, the daily closing and opening of the discharge gate was successful in maintaining DO above the water quality objective of 5.0 mg/L in the receiving water. However, this corrective action likely exacerbated the already low DO levels in the pond. The discrete monthly monitoring of DO in the pond, which occurred between 8:00 and 10:00 a.m., showed pond DO levels for July, August, and September of 1.15, 1.94, and 0.07 mg/L, respectively. Thus, there appears to be a conflict between adaptive management of the pond discharge to preclude excursions below the water quality objective in the receiving water (closing gates when pond DO is low) and adaptive management to optimize DO levels in the pond (opening gates to increase flow-through). Nonetheless, the management of A18 during the summer of 2005 resulted in a satisfactory balance of meeting receiving water requirements and minimum pond needs for dissolved oxygen.

c. Lessons Learned

- The discharge of highly saline waters into Artesian Slough from Pond A-18 appeared to have only temporary effects on receiving water benthos, which recovered within 6 months of the initiation of pond discharge (Figure 6). This confirmed an important assumption of the ISP.
- During the hot summer months algal blooms in A18 caused a diurnal, sinusoidal pattern of high dissolved oxygen concentrations in the pond during the day due to photosynthesis and low DO at night due to oxidation and respiration (Appendix 7). Opening the discharge during the day and closing it at night was successful in meeting the water quality objective of 5 mg/L in the receiving water. However, there was little room for error since closing the discharge gate too long could result in even lower DO conditions within the pond. If a future episodic event (e.g. breaching the Island Pond levees) resulted in lowering the DO levels of the influent to Pond A18, and if the 2005 adaptive management approach for A18 was followed, the City may be compelled to close the gates for more than one day. This, in turn, could cause the DO levels in the pond to collapse.
- One of the most significant lessons learned in the operation of A18 in 2005 was that the adaptive management applied to the A18 discharge with regard to meeting the Basin Plan DO objective of 5 mg/L in the receiving water was perhaps too rigorous (Appendix 7). For example, although the weekly 10th percentile DO concentration in the pond discharge for the week ending June 14th was less than 3.3 mg/L, the receiving water DO did not appear to be impacted by the low DO in the discharge (Appendix 7, Week 6; note June 14th data). During the week of June 5th to 11th, the pond 10th percentile DO value was only 4.11 mg/L but this had no effect on the weekly diurnal pattern of DO in the receiving water (Appendix 7, Week 5). Although the DO in the discharge appears to follow the same trend as DO in the receiving water (Appendix 7, Weeks 1-5), much of this relationship appears to be associated with tidal cycle and oxygen solubility. Fresher water during an outgoing tide has high DO while the more saline water following the daily higher high tide has lower DO (Figure 7; Appendix 7, Week 7). Finally, when the discharge gate was accidentally left open on July

13th, this appeared to have little or no effect on receiving water DO levels even though DO in the discharge was near zero for over four hours (Appendix 7, Week 10). These data strongly suggest changes to the adaptive management approach as discussed in the 2006 Plan below.

- Following the initiation of adaptive management on June 14th, a noticeable algal bloom was observed throughout the pond for the remainder of the summer. As expected, algal photosynthesis produced large diurnal swings in DO. However, the quickness of the DO change was surprising. For example, on July 6th pond DO went from 0.14 to 8.51 mg/L during a 15-(minute period starting at 11:30 a.m. (Appendix 7, Week 9).
- The discrete monitoring undertaken in 2005 proved to be very helpful in describing the salinity wedge in Artesian Slough (Figure 2). The salinity wedge was also used to hypothesize why the recovery of benthic invertebrates occurred so rapidly and so completely. Nonetheless, the discrete monitoring of water quality in the receiving water is not likely to be particularly helpful now that the Initial Discharge period and the first year of monitoring are over. The salinity wedge occurred as expected in Artesian Slough and the recovery of the benthic community was perhaps even better than expected. This latter marker would appear to indicate that the DO on the bottom is not critical as long as the water quality objective of 5 mg/L DO is being met at the surface of the receiving water.
- The trend of greater monomethyl mercury in sediments in the northern part of the pond as compared to the southern area of the pond is interesting. Hopefully, the required monitoring of mercury in 2006 will help to clarify or confirm the 2005 results.

4. Winter Operation

As described in a letter dated December 22, 2005, the City is requesting that the Regional Water Board allow Pond A18 to be operated with increased circulation rather than the minimal circulation described in the operations plan. This would allow greater flushing and potentially improve water quality. City staff did not receive comments on the winter operation plan from the Regional Water Board and has proceeded to operate A18 in a muted tidal mode as of January 26, 2006.

5. 2006 Plan

The City proposes to continue monitoring using two continuous monitors, one at the discharge and one at the 100-meter station (A-A18-5) in the receiving water.

Cargill received a letter from the Regional Water Board on September 7, 2005, indicating that the Regional Water Board prefers monitoring DO at the bottom of the slough rather than the top as is currently being done. The City has several concerns with this approach. First, there are logistical issues. Locating the monitor on the bottom will increase fouling and will require greater maintenance and staff resources. Fouling and increased likelihood of equipment damage may result in loss of data. The second concern is that placing the monitor on the bottom will not allow accurate comparisons with the 2005 data. Management decisions will likely be more appropriate if based on the examination and analysis of comparable data. Finally, implementing

the Basin Plan dissolved oxygen objective of 5.0 mg/L “within one foot of the water surface” as stated in the Order did not have a prolonged negative effect on the benthos, which recovered within six months of the initial release of highly saline water from Pond A18. The City believes that continuing to apply this standard will protect the benthos as well as water column biota, especially since the period of greatest disturbance (Initial Release) to receiving waters has ended. Therefore, the City proposes to continue monitoring one foot below the water surface to allow comparison to the 2005 baseline data, enabling the City to learn more about the effect of Pond A18 discharge on the DO in the receiving water.

The City believes that discrete monthly monitoring of water quality (temperature, pH, DO, salinity) in 2006 may be of little additional benefit beyond what was already learned in 2005 if 2006 summer pond operations remain unchanged from 2005. If pond operations were changed as described below to maximize discharge, discrete monitoring would continue to compare how a change in operations may affect the receiving water. If the Regional Water Board does not approve the proposed changes, the City recommends discontinuing discrete monitoring.

As discussed in lessons learned, the data (Appendix 7) indicates that adaptive management implemented by Cargill to address low DO levels may have been too rigorous and may have resulted in prolonged depression of DO levels in the pond. The City proposes a more flexible approach to better balance DO levels within the pond and receiving water based on a weekly evaluation of the data. Instead of triggering adaptive management immediately involving gate closing, if the weekly 10th percentile DO value for the discharge falls below 3.3 mg/L, adaptive management would be implemented only if the receiving water DO level has also fallen below the Basin Plan objective of 5 mg/L. In cases where the receiving water experiences only minor excursions below the objective, the Regional Water Board would be consulted. This approach should allow for the maximum pond discharge without impacting receiving water DO levels. If gate closing is required, the City will continue to adaptively manage gate operations to find the optimal timing.

The City expects that breaching of the Island Ponds (A19, A20, A21) may affect the management of A18 since the breach location is near the intake to Pond A18. If the DO of intake water to the pond is lower than in 2005, this could exacerbate the overnight low DO conditions observed this past season. In managing those ponds, the owners should be required to monitor the receiving water for DO and other effects of the Island Ponds releases.

As additional information is collected based on the current winter operation and Island Pond breaching, the City may request additional modifications to operations and monitoring of Pond A18.